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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/602,266	06/23/2003	Masao Moriguchi	SLA 0770	1706

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EXAMINER	
PADGETT, MARIANNE L	
ART UNIT	**PAPER NUMBER**
1762	

DATE MAILED: 09/19/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/602,266	MORIGUCHI ET AL.	
	Examiner	Art Unit	
	Marianne L. Padgett	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 June 2003*.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-64* is/are pending in the application.

4a) Of the above claim(s) *49-64* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-48* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *6/23/03*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-48, drawn to a method for producing a polycrystalline silicon, classified in class 427, subclass 554.

II. Claims 49-64, drawn to a thin film and transistor, classified in class 428, subclass 688.

2. The inventions are distinct, each from the other because of the following reasons:

Inventions Group I and Group II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case, the product may be made by a materially different process, such as solid phase crystallization and furnace annealing.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

4. During a telephone conversation with David Ripma on January 23,2006 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-48. Affirmation of this election must be made by applicant in replying to this Office action. Claims 49-64 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

6. Claims 1-48 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In the claims, such as applied for of independent claim 1 the modifier "2N" describing "2N-shot laser" is vague and indefinite as it contains what appears to be an undefined variable, or possibly an undefined abbreviation.

The body of independent claim 1 is not commensurate in scope with its preamble, which requires there to be produced "grain boundary-free polycrystalline silicon", since the actual steps in the body of the claim do not have any requirements concerning grain boundaries or lack of them to be formed, when the polycrystalline is produced.

Claim 2 is ambiguous, in that it is unclear whether "odd and even iteration patterns" and their related "odd numbered iterations" & "even numbered iterations" are referring to 2 separate process sequences where an odd number and an even number of iterations are preformed, respectively, or whether the limitations are referring to only one sequence of iterations, where the limitation of lines 5-7 are preformed every other iteration, which is oddly numbered & the limitation of lines 8-10 are preformed on the even numbers of that sequence of iterations. The examiner suspects that the latter option is intended, especially given the further limitation claim can, however clarity in the claim language is needed. In either option is not clear how the claimed "two steps" relate to the odd or the even numbered iterations, or one might ask "two steps" doing what? It is noted that due to insufficient context that "two steps" may also be considered ambiguous, as possibly referring to "steps" in the sense that processes are made up of a series of steps, or alternately steps might refer to some kind of motion.

Claims 3 and all the claims dependent therefrom, are further vague and indefinite as they specifically and explicitly contradict the preamble of the independent claim from which they depend as they require there to be grain boundaries contrary to the preamble of the independent claim, with further

dependent claims to being explicit dimensions for the grain boundaries which are not supposed to exist. As noted that some of claims dependent from three remote grain boundaries, but unless they remove all grain boundaries that have been required to be produced, then the polycrystalline silicon is not "grain boundary-free", and would still contradict the independent claim from which it depends.

In claim 11, the step of "advancing the third aperture pattern and the second area top surface in the first direction" is ambiguous as it is unclear if the intent is to move both the pattern and the substrate together (i.e. the surface in the aperture are advanced together in the same direction such that there is no relative motion between them & no logical purpose for doing this), or if the intent is to advance the aperture pattern, such that it advances along the first direction of the second area top surface. Alternately, the language could be said to be clear, as the first option is what claim 11 literally says.

It is noted that claim 13 makes selections, but does nothing with these selections (not a 112 problem in itself), where claims 14 & 16-17 ultimately dependent therefrom, uses the language "to be co-located...", which is not a positive statement of something occurring, merely a potential, such the claims 14 & 16-17 have no positively claimed requirement, thus it is uncertain whether they are intended to, as presently written.

It's unclear what claim 18 is intending to add as a further limitation, because the first two lines of claim 18 repeat the limitation of lines 3-5 of claim 11, from which it depends, and the examiner doesn't understand how the first direction can be anything other than the first direction since it has already been to font. It can't be different than itself, hence it must be the same, therefore it appears that as written the "includes..." limitation is merely paraphrasing previous requirements! Claim 18 might make some sense if applicants were claiming performing the operation in the same position, within the first area, but nothing like that has been defined or claimed.

In claims 22 & 24, it is unknown what is intended by "projecting the first laser beam by a factor of one". A laser beam is a col. of light output by a laser, thus has a general shape by definition, but the

examiner can't think of any mean that "by a factor of one" could supply to describing the laser beam or the protection of it! A same language is found on page 23, line 2 & page 25, line 22 of the specification, but the context is the same and provides no further indication of what is intended by this phrasing.

In claims 25 & 28, it is unclear how these claims' steps relate to the preceding steps of claims 1+2+3, from which they depend since there is no step in these preceding claims where "projecting a first laser beam to in yield the first area" occurs, since the step in claim to for projecting the first laser beam is used "to form polycrystalline silicon in a first area", not to anneal. The only claimed a kneeling in the preceding limitations, is in the last listed step of claim 1, which uses DS to anneal the second area, which is in the first area. Are these intended to be two separate annealing steps in claims 1, and 25 or 28, or is the intent of the claim to use the first laser for both the polycrystalline formation step & the DS annealing, or was there an inadvertent mix-up in the nomenclature, or what?

In claim 25, what action is intended by the last limitation of "annealing the first area in response to the third energy density" recited in the last two lines of the claim is unclear, because one has already preformed 2 annealing steps with the first and second laser beams, that have first and second energy densities, whose sum = the third energy density. What one is supposed to do in response to the sum of the energy density of the first two annealing steps is completely incomprehensible and undeterminable for the claims as written. Claims 28, 32 & 35 have analogous language, thus are similarly unclear as to what is intended to be done in response to the sum of the previously applied energy densities.

Claims 30 & 31 do not make sense, as they appear to be impossible with respect to previous requirements of independent claim 1+ claim 28, unless one is annealing before using the laser to make the first area polycrystalline. (This may also relate to the uncertainty that discussed above with respect to claims 25 & 28). Further, it is unclear how the "a first bottom surface" or "a first top surface" relate spatially with respect to the previously introduced first area & second area. Are top and bottom arbitrarily designated portions, presumably at edges of the first area, or is the film freestanding and more properly

called a substrate, where one is discussing two different sides of an amorphous silicon substrate (but one would not normally discuss "forming a film of amorphous silicon" as in claim 1, if this were the case)? Claims 37 & 38 have analogous problems, except claim 11 and the annealing of the second area, are consistent with the annealing step of claim 1.

In claim 39, it is unclear if "a transparent substrate layer" is the substrate or a layer on the substrate. Furthermore, since no limitations connecting the laser irradiation and annealing steps of the independent claim or claim 11 are included in claim 39, it cannot be determined from the claim language whether the steps forming these various device features in claim 39 are done before, after, during or how they are related to the annealing steps. Although one might assume that the layers formed over the first and second areas' device features are done after the irradiation in annealing steps, this does not necessarily have to be so, depending on whether or not they are transparent to the light employed. There is nothing in the claims to relate when the forming of the channel or source and drain regions occur with respect to any of the preceding claims processes, thus it is unclear how the two sets of limitations relate to each other. For the limitation of "a transistor channel with a length, oriented in the first direction", the examiner assumes that is the length that is oriented in the first direction, but has no idea if there something else about a transistor channel that can be oriented. With respect to the source and drain regions being adjacent to the channel region, there are numerous possible configurations, but are all really intended?

Claim 40 is unexaminable with respect to preceding limitations, since independent claim 1 declares that there are no grain boundaries, and while claim 3 contradict really creates grain boundaries in the first area, claim a leaven that removes grain boundaries in the second area, so that it appears that there are actually no grain boundaries in the second area where the channel region is supposed to be being formed, hence it would appear to be impossible to follow the directions of claim 40, that is if the "a pair of first plurality grain boundaries" (emphasis added) or "... second..." are somehow related to "a first

plurality of parallel grain boundaries" or a second..." from claim 3. If the steps of claim 1 have already been done the grain boundaries aren't there or have been unclearly described, but if caught the steps of claim 1 have not yet been done, one might be up to follow the directions if one could figure out what in the world a "plurality grain boundary" was. Also see claims 41-45 for confusing language.

With respect claim 45, it is further noted that claim 40 from which it depends does not form either of the pairs of "plurality grain boundaries", and that the language of claim 45 shows no antecedent basis which could clearly connected to the grain boundaries formed in claim 3, through which the chain of dependence flows, such that the introduction in line 3 of claim 45 of "first and second width", may or may not relate to the like terms used in claim 3 with the uncertainly related grain boundaries formed therein.

Use of abbreviations in the claims without first defining them in a claim sequence is improper. In claim 46, see "TFT". Also how can a voltage at the same time be both "less than and equal to"? While these range options for a threshold voltage make sense as alternatives, they sound fairly impossible for simultaneously existing. A threshold voltages are noted to appear to be values associated with intended use of the final product in a certain range, but are not necessarily such, but merely a threshold for some unstated purpose or effect, for a voltage range that may never be applied, hence this examiner would have no idea how are means to determine a threshold voltage for an unstated purpose or effect. Also see claims 47 & 48 for similar language in the limitations therein.

Also in claims 46-48, it is unclear how forming a single transistor channel can be done so that its carrier mobility parameter is for both p-type and n-type TFT's at the same time, except when both p- & n-types may have the same value, which is indicated to be possible by these claims, but also the claims include a nonoverlapping part of the range of values, and indicate that the transistor channel is formed for both types at once, instead of alternatively for one or the other.

Given the above described problems, careful proofreading of the claims and any amendments thereto for consistency of nomenclature, intent and logic is recommended.

7. Claims 3-48 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Claims 3 and its dependent claims, as discussed above in section 6 above, as written broaden the scope of the process by requiring the production of a specific configuration of grain boundaries, when the independent claim from which they depend, excludes any grain boundary from being present, by the requirement of its preamble, which presently is not clearly tied in with body of the claims. It is noted that claim 11 requires "selectively removing grain boundaries in the second area", but that leaves grain boundary still existing it all parts of the first area that do not overlap with the second area, where it is noted that claim 1 includes the second area in the first area, not the other way around. Claim 12 explicitly leaves grain boundaries during the removing sequence, this maintains the contradiction of claim limitations & broadening the scope.

Claim 18 does not add any determinable new limitation to its claim sequence, as presently written (see above).

8. The disclosure is objected to because of the following informalities: it appears that figure 4 is supposed to be described in the paragraph bridging pages 6-7, however the examiner nothing in this paragraph that appears connected to the figure containing nine squares with different patterns, 4 of which appear to be labeled (a), (b), (c) & (d). Page 3, line 24 says that "Fig. 4 illustrates steps in a 2N-shot process with N = 2", but it is not clear to the examiner from what is written on pages 6-7, why this description is at all appropriate to figure 4.

Appropriate correction is required.

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

10. Claim 1 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, or 1-2, or 1-2, 7-10 & 13-14, or 1 & 7, or 1-9, 11-17, 19-20 & 22-24, or 1, 3 & 12-15, or 1-5 of U.S. Patent No. 6,635,555 B2, or 6,664,147 B2, or 6,709,910 B1, or 6,818,484 B2, or 6,913,649 B2, or 6,921,434 B2, 6,495,405 B2 (Voutsas et al.), respectively. Although the conflicting claims are not identical, they are not patentably distinct from each other, because while having different scopes and orders of claiming various limitations, all of these patents have laser treatment of amorphous silicon films or surfaces, where pulsed lasers are employed, including multiple pulses applied, and where some form of directional solidification (generally using the term lateral or laterally) occurs in a process that may be called annealing, hence while generally more detailed than the present claim 1, all of these patent claims encompass the present claim 1. It is further noted that while applicant's claim 1 relates the laser irradiation process to being preformed <u>in</u> "a first area" and the SD annealing is being done <u>in</u> a "second area", this second area is either enclosed by or the same as the first area, and from the claim language there is no necessity that the laser irradiation and the anneal are necessarily different processes, such that one could be employing the laser irradiation to cause the directional solidification. Also the claimed "a film of amorphous silicon", while encompassing such a film formed on a substrate, also encompasses a freestanding film, i.e. at amorphous silicon substrate. The differences, such as order of claiming, or more detailed further limitations, are considered obvious variations on the general theme of laser irradiation to make a polycrystalline silicon surface.

Note that since the preamble requirement of "producing grain boundary-free polycrystalline silicon", as it has not been included in any way in the steps of the body of the claim, and is contradicted by further dependent claims as discussed above, has not been considered as a clear or positively claims limitation, hence is not considered with respect to these patented claims.

Note with respect to Voutsas et al. (405), that while no lasers are mentioned in the claims, the acronym ELA used therein is defined on col. 1, line 64-col. 2, line 10, as "excimer laser annealing", which is described as directing high energy laser pulses to selected regions, were typically each laser pulse covers only a small area and the substrate or laser is stepped through an exposure pattern, hence the claimed annealing of a plurality of regions of amorphous silicon "using a lateral crystallization ELA process to form polycrystalline regions having elongated grain structures with a first orientation..." is consistent with the present claims' 2N-shot laser irradiation & directional solidification to produce polycrystalline silicon & anneal, for reasons discussed above.

11. Claim 1 is provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-42 of copending Application No. 10/384,888. Although the conflicting claims are not identical, they are not patentably distinct from each other because reasons as discussed above in section 10. In this application perfectly note claims 14 & 30.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

12. Claims 1-10 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-4, 6, 9, 15-16 & 18-21 of U.S. Patent No. 6,573,163 B2. Although the conflicting claims are not identical, they are not patentably distinct from each other, because while having different scopes and orders of claiming various limitations, like the patents listed in section 10, this patent to Voutsas et al. (163) also has laser treatment of amorphous silicon films or surfaces, where pulsed lasers are employed, including multiple pulses applied in a pulse sequence, and where some form of directional solidification (lateral crystallization, ELA) occurs in a process that may be called annealing, hence the patent claims encompass the present claim 1. Furthermore (163) employs a first mask, that may have a plurality of parallel slits at a first orientation, and on a second laser application that may read on a second or even iteration, employs a second mask that also may have a plurality of parallel

slits, but at a second orientation, where the first and second orientations may be substantially perpendicular to each other, hence while varying in scope or claimed in different orders of introducing limitations or phrasing the cover slightly different, but overlapping scopes, these differences may be considered obvious variations on the claimed process of forming polycrystalline regions.

General comments set forth in section 10 above also apply here, noting that (163) includes limitations concerning "TFT structures having channels oriented substantially parallel to elongated grain structures with a first orientation" or "using a lateral crystallization ELA process to form polycrystalline regions have been elongated grain structures...", which while implying the presence of grain boundaries (i.e. are not grain boundary-free due to the present of grains), are consistent with structures formed in applicants' claim 3, which as presently claimed contradict the present independent claim 1's preamble. While the claims of (163) do not have specific dimensions to go with their claims of elongated grain structures, it would have been obvious to one of ordinary skill in the art to adjust their irradiation parameters in order to produce grains of the size appropriate to the particular device being made with the specific (amorphous silicon) film being treated, where the various ranges within the claimed 0.1-100 micrometer range are within dimensions generally known to be desirable for various parts of devices formed in semiconductor processing, hence would've been expected to be among the appropriate sizes considered.

13. Claim 1 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-16, or 1-11, or 1-10, or 1-19 of U.S. Patent No. 7,018,468 B2, or 7,056,843 B2, or 6,606,971 B1, or 6,881,686 B1, respectively. Although the conflicting claims are not identical, they are not patentably distinct from each other, because while having different scopes and orders of claiming various limitations, all of these patents have laser treatment of silicon films or surfaces, where pulsed lasers are employed, including multiple pulses applied, and where some form of directional solidification (generally using the term lateral or laterally) occurs in a process that may be called

annealing, hence while generally more detailed or with a different emphasis than the present claim 1, all of these patent claims encompass the present claim 1, for reasons as discussed in section 10 above, except they differ by not requiring the silicon surface being treated to necessarily be amorphous, however generic silicon surface encompasses the specific species of amorphous silicon, and it would have been obvious to one of ordinary skill in the art that when performing a process to create a polycrystalline microstructure in a generically named silicon surface that one of the most obvious options to employ in these claim treatments would have been amorphous silicon, because it is a more economic starting material than starting with the few other species in this small group, such as single crystal silicon, and furthermore is old and well-known to be a material that is crystallized during device processing.

14. Claim 1 is provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 2-18 of copending Application No. 11/263,604. Although the conflicting claims are not identical, they are not patentably distinct from each other because reasons as discussed above in sections 10 & 13. In this application it is noted that both the laser heating source (CO_2 laser) & the laser annealing source (excimer or solid-state laser) may be pulsed lasers, providing multiple ways of supplying plural laser shots to the process, as presently claimed.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

15. Claims 1-44 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 3-9 & 11-46 of U.S. Patent No. 6,939,754 B2 (Moriguchi et al.), in view of Fukunaga et al. (2004/0142543 A1) or Kawasaki et al. (6,653,657 B2).

Moriguchi et al. (754) claim a process of forming polycrystalline silicon in a first area from an amorphous silicon film, and annealing a second area, which is included in the first area using a laser induced lateral growth process (≡ 2N-shot or directional solidification). Sequences of mask use and orientation as claimed in the present case are also claimed in the patent, as are sequences of laser and/or

lamp usage with respect to energy density, various associated parameters, as well as device formation dependent claims somehow related to the polycrystalline production process. The claims of Moriguchi et al. (754) differ by specifying that metal is used to induce the formation of the polycrystalline microstructure, as opposed to requiring "2N-shot laser irradiation" of the present claims, however use of a metal catalysts to induce crystallization in the independent claim 1 of (754) does not specify what energy source is employed to energize the reaction. It would have been obvious to one of ordinary skill in the art to employ in this claimed process any energy source known to be effective for metal catalyzed crystallization of amorphous silicon to produce a polycrystalline silicon, such as is disclosed in Fukunaga et al (abstract; [0030]; [0087-89]; [0111]; [0128-130]; [0144]; [0156]; & claims), who teach use of lasers, such as KrF excimer lasers, to crystallize amorphous silicon that has had a catalytic element, such as nickel deposit thereon, especially given further analogous teachings of performing further annealing treatments on the crystallized area to improve the crystallinity thereof, along with teachings of lateral growth ([0052-57]; [0059-67]; [0092]; [0114]; & [0131-133]), such that one of ordinary skill would have expected the taught laser crystallization using a catalytic element of Fukunaga et al. to have been effective for the crystallization step of Moriguchi et al.

Alternately to Fukunaga et al., Kawasaki et al. (657) teaches crystallization of amorphous silicon to form polycrystalline with lateral growth, where the crystallization procedure may use heat or laser (single or dual lasers, excimer with single or plural pulses), and may be performed with or without a catalytic element (abstract; col. 1, line 28-col. 2, line 6; col. 3, lines 14-32 & 56-68+; col. 6, line 20-col. 7, lines 68+), hence providing a further showing of the obviousness of using laser crystallization as the energy source for the initial crystallization process of these claims.

16. Yamazaki (7,001,829 B1; abstract; figures 1-3, etc.; col. 2, lines 17-55; col. 3, lines 51-63+; col. 5, lines 36-68; col. 7, lines 16-col. 8, lines 41; col. 10, lines 35-65; col. 11, lines 9-51; col. 12, lines 6-44; etc.) has teachings equivalent to Fukunaga et al. for the purposes of the above rejection,

teaching (excimer) laser irradiation of amorphous silicon with a catalytic element introduced, that introduces crystal growth in the direction parallel to the substrate (e.g. lateral), and may be performed with one irradiation shot (e.g. pulse) using a plurality of lasers to cover large areas. Yamazaki et al. (7,084,016 B1; abstract; figure 1+; summary, especially col. 2, lines 13-23 & 39-col. 3, lines 3 & 13-20; col. 4, lines 7-25; col. 6, lines 7-40 & 65-col. 7, lines 20 & 48-col. 8, line 8; col. 11, lines 3-20+) has similar teachings.

The patent to Mackawa (5,940,693), also has teachings equivalent to the purposes for which Fukunaga et al. & Kawasaki et al. were applied above. Particularly see the flowchart of figure 16, step 108, discussed on col. 13, lines 18-40, where amorphous silicon may be annealed to form polycrystalline silicon using lamp or laser or furnace techniques, with the production of lateral growth.

17. Claims 1-10 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-14 of U.S. Patent No. 6,727,125 B2 (Adachi et al.). Although the conflicting claims are not identical, they are not patentably distinct from each other, because while having different scopes and orders of claiming various limitations, like the patents listed in section 12, this patent to Adachi et al. (125) also has laser treatment of silicon films or surfaces, where lasers using a step and repeat procedure are employed, thus including multiple pulses applied in a pulse sequence or encompassing possible meanings of "2N-shot", and where some form of directional solidification (laterally growing crystals) occurs in a process termed annealing, hence the patent claims encompass the present claim 1. Like (163), Adachi et al. (125) employs a first mask, that may have a plurality of parallel slits at a first orientation, and on a second laser application that may read on a second or even iteration, employs a second mask that also may have a plurality of parallel slits, but at a second orientation, where the first and second orientations may be transverse directions (i.e. perpendicular). Adachi et al. (125) differs by claiming use of this laser/annealing process on a silicon substrate, instead of amorphous silicon, however arguments as applied in section 13 above, also apply here. Furthermore,

while varying in scope or claimed in different orders of introducing limitations or phrasing the cover slightly different, but overlapping scopes, these differences may be considered obvious variations on the claimed process of forming polycrystalline regions.

General comments set forth in sections 10 & 12 above also apply here.

18. Claim 1 is rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 1-26 of U.S. Patent No. 6,686,978 B2 (Voutsas), in view of Fukunaga et al. (2004/0142543 A1)

The claims of Voutsas (978) differ from present claim 1 by not specifying that their sequence of laser pulses that produce oriented crystals do so in a "directional solidification process". Nor do the claims mentioned the present preamble's "producing grain boundary-free polycrystalline silicon", whose significance is confusing and unclear for reasons discussed above, so does not presently can tribute significance to application claim 1. The secondary reference, previously discussed in section 15 above, like Voutsas (978)'s claims is directed to crystallize the amorphous silicon, via analogous laser irradiation/annealing processes, where the crystallize silicon may be employed in liquid crystal devices (figure 10; [0002] embodiment 3, [0108]; embodiment 4, [0141]; etc.), and is taught for cases of forming electronic devices using regions where the crystal growth has proceeded horizontally (i.e., parallel with the substrate), which is to say that the growth is lateral or directional, thus reading on the claimed directional solidification ([0094]; [0098-99]; [0126]; [0130], etc.). It would have been obvious to one of ordinary skill in the art to optimize the laser annealing process of sequenced laser pulses in the claims of Voutsas (978), so as to produce the taught horizontal or lateral crystal growth as taught in Fukunaga et al., in order to confer the taught electrical stability and reliability in resulting devices as is produced with such techniques, especially considering further teachings of enhanced crystallinity, where the crystalline silicon film produced has no clear crystal boundaries at any particular location ([0156-0157]).

19. Other copending cases of interest include: Voutsas et al. (6,809,801 B2) who has claims directed to laser projection irradiation crystallization methods that may be used on semiconductor films that are related to present claims 22, 24, 28-32, 35- 38, but like the intervening claims details concerning irradiation techniques more specific effects; and serial number 11/479,221, who is present claims are directed to making similar products (TFT structures), with the pending claims (presently nine) directed to laser annealing amorphous silicon to produce polycrystalline silicon, but lacks any further laser irradiation/annealing details.

20. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Sano et al. (6,767,773 B2).

Sano et al. teach a laser crystallization process for amorphous silicon layer that has been shaped, were different areas are crystallized in different fashions. Particularly for an amorphous silicon layer shaped as in reference #3 in figures 1-7 (col. 6, lines 1-40; & col. 7, lines 10-col. 8, line 68+, especially col. 8, lines 17-24 & 28-35), which has wide regions 3a and a narrow connecting region 3b. The wide areas are laser scan with an excimer laser to cause crystallization producing polycrystalline silicon regions, while the narrow region is laser scanned with a constant wave (CW) solid-state laser, such that the solid-liquid interface moves parallel to the narrow region controlling the direction of crystal growth, thus producing a directional solidification therein as claimed, and might also possibly produce what applicants may have intended by their preamble claim of "grain boundary-free polycrystalline silicon", since this particular region produced is grain boundary-free. It is noted that Sano et al.'s reference #3 may be considered to read on applicants' claimed first area, since the excimer laser treatment reads on the "2N-shot laser irradiation process to form polycrystalline silicon in a first area", as regions 3a are in the area described by reference #3 (≡ first area), and whether one or multiple pulses are used from the pulsed excimer laser, its use reads on the vague and indefinite limitation of the claim, with its undefined variable "N", that could represent a fraction or an integer or whatever. The narrow region 3b is

in #3 ≡ first area, hence read on the claimed second area, which is inside or the same as the claimed first area.

However it is noted that, the scanning as illustrated in figure 7 and the need to treat 2 separated areas 3a would have suggested to one of ordinary skill in the art that at least two pulses were employed, one for each sub-area, and obviousness consideration that applicant might consider if they provide a clear definition for "N". For further discussion in Sano et al. for the importance of grain boundary control, crystal growth direction and its importance in TFT channels see col. 3. While polycrystalline layer 5 might be said to form an aperture about the narrow neck region 3b, there is no feature that appears to form a second aperture or aperture pattern in this process, such that even while applicants' claim 2 is not particularly clear, none of its probable meanings appear to read on the process of Sano et al.

21. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Fukunaga et al. (2004/0142543 A1).

Fukunaga et al. is described above in section 15. One possible interpretation of claim 1 as it is presently broadly written includes first area = second area, and that the "2N-shot laser irradiation process to form polycrystalline silicon" = directional solidification process to anneal, which would read on Fukunaga et al. is laser annealing process as described in paragraphs [0089], [0111] & [0128-130], where laser treatment (KrF excimer laser) of several shots irradiates a selected area to crystallize the amorphous silicon (plus catalytic nickel), such that the crystal growth proceeds parallel to the substrate, i.e. is lateral, will which is a direction so is directional, thus reading on all aspects of applicant's claim is written. Alternately, Fukunaga et al. also may have a further radiation treatment to enhance the crystallization that may use a strong light such as an infrared lamp or may use a second laser irradiation procedure, where this annealing step after the initial crystallization step is also said to proceed or is on to lead in its crystal growth ([0099], [0114] & [0131-132]), which would read on the alternative option of the laser irradiation

process being different from the directional solidification annealing process, but where first area still equals second area.

22. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamasaki et al. (5,894,137), in view of Fukunaga et al. or Kawasaki et al. (6,653,657 B2).

Yamasaki et al. (137) teach a crystallization process of amorphous silicon, which has been coated with a silicon oxide film having an aperture that exposes region 405 on to which a catalytic element, such as nickel is introduced, and thereafter heating is performed to cause crystallization, where lateral growth occurs, however grain boundaries that occur between adjacent crystals that are perpendicular to the direction of crystal flow in the base region, i.e. channel result in potential barriers and hinder the flow of current. Therefore to improve the crystallization in these areas and create "monodomain regions" that are substantially single crystal with no grain boundaries in the crystalline silicon, it is further taught to improve the crystallization via application of laser beam such as excimer lasers (KrF at 248 nm or XeCl at 308 nm) or rapid thermal annealing using strong light from IR or UV lamps. This annealing of the lateral growth region is locally heating high temperatures such that the metal silicide from the catalytic element is precedently melted, eliminating grain boundaries, In re solidifying to form essentially a single crystal domain in such a way that can be considered to remain lateral or directional. See the abstract; figures; col. 4, line 5-col. 5, line 14 (influence of grain boundaries in TFT); col. 6, lines 39-55; col. 7-8, especially col. 7, lines 10-15, 35-44 & col. a, lines 20-35; col. 9, lines 41-65; col. 11-line 6-55; col. 12, lines 5-42; col. 13, lines 1-60 & 66-col. 14, line 5.

Yamasaki et al. (137) differs from the present claim by initially turning the amorphous crystal into polycrystalline via a thermal process, however as has been seen above with respect to Fukunaga et al. or Kawasaki et al. (sections 15 or 21) it was known to provide equivalent lateral growth crystallization processes using catalytic elements employing either her thermal or laser processes, hence as discussed

above it would've been obvious to one of ordinary skill in the art to employ the alternate technique of laser treatment, instead of the purely thermal treatment to induce the crystallization formation.

It is noted that Yamazaki uses apertures in his process, and it would've been obvious to one of ordinary skill to use multiple apertures in a process to produce multiple polycrystalline regions forming multiple TFT structures, since designs for circuitry require multiples of such functional structures, however for the claims are presently written, it is unclear whether such a procedure would relate to applicants' claim 2 & subsequent claims, or not since the claims are so unclearly written to not clearly relate the various features of the claim, such that clear processing sequence can be determined with respect to the different claimed limitations.

23. Other art of interest include Cho (2005/0176189 A1), Kim (2004/0106244 A1 & 2004/0266078 A1), which are of interest to the State of the art, but are not prior art.

Yamasaki et al. (6,396,105 B1 & 2002/0093061 A1) have teachings concerning laser crystallization & grain structure analogous to that of Yamasaki et al. (137), hence could be applied equivalently to the claims is presently written. Yoshimoto (7,078,321 B2) also has similar teachings concerning laser crystallization, lateral growth and use of a phase shift mask therefore (especially see figure 6 & col. 10+13).

24. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Sposili et al. (6,577,380 B1).

Claim 2-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sposili et al. (380).

Sposili et al. teach irradiation using a pulsed laser source to cause melting and solidification in a sequential lateral solidification (SLS) process, where the substrate and/or mask are concurrently translated in a manner coordinated with the laser pulses, so as to laterally extend the crystal, hence its grain boundary with each sequential pulse or stepped translation. Sposili et al. teach use of a patterned laser

beam and a repetitious process that may control and reshape the laser beam or beam spot, teaching that many configurations are available, depending on the desired shape and application, including that different variants of the SLS process can be conducted on different areas of the substrate, so as to optimize microstructure and throughput as appropriate to the desired application, where the mask employed can be translated or rotated, for producing different patterns in between processing runs, or during processing. See the abstract; col. 1, lines 20-25; col. 2, lines 1-40; col. 3, line 46-col. 4, lines five & 25-66; col. 5, lines 8-25 & 47-56; col. 6, lines 15-50; col. 7, lines 11-22+; col. 9, lines 34-60; & col. 10, lines 10-20.

It is noted that the SLS process combines both the claimed laser irradiation and directional solidification annealing processes, where the areas may be the same, or the arbitrary designations of the claim may correspond to areas treated as described in Sposili et al. (380). With respect to the aperture usage in claim 2, it may be considered encompassed by the more general and very versatile teachings of Sposili et al. concerning masking patterns, translations or rotations & the possibility of producing are using different patterns during a process. While Sposili et al. do not specify shifting between apertures or configurations on odd and even iterations, i.e. alternatively, the capability changing of patterns during processing, can be considered inclusive and suggestive of such, especially considering that as written in claim 2, the iterations and use of two aperture patterns have no affect or purpose, the aperture patterns have no particular shape either in and of themselves, or with respect to each other, except that these unspecified shapes are somehow considered to have orthogonal directions, which given their shapeless nature could never be determined by the examiner to mean anything in particular, alone or with respect to each other. In other words as presently claimed, the aperture usage has no more meaning than an arbitrary design choice, and as such would have been obvious to one of ordinary skill in the art depending on desired shapes for particular application designs.

With respect to the parallel grain boundaries of claim 3 & the claims dependent therefrom, the SLS technique inherently creates grain boundaries at its edges, which as it scans or steps would create a plurality of essentially parallel grain boundaries on opposite sides of the crystallize grain, which for a controlled beam spot & controlled parameters would inherently be equally spaced. The choice of the width would depend on desired enduse combined with parameter control of the laser beam, and as such would have been expected to include widths as claimed, since they are typical dimensions desired for electronic features in semiconductor devices like TFT's, such as are to be formed with the crystallize products of this reference. That Sposili et al. may use plural patterns in processing of the substrate would indicate that there may be different sets of such crystallized silicon film, with different or the same width, depending on the design requirements for the particular circuitry being created. Alternately, for mass patterns that are square or worked rectangular as shown in the mask 8 of figure 5, each pulse would give two sets of orthogonal parallel grain boundaries, where patterns with multiple apertures, exemplified by the set of 4 rectangles would provide a plurality of such parallel grain boundaries, where squares would have first and second widths equal, while rectangles widths are unequal.

It is further noted that the sequential lateral solidification employed by Sposili et al. effectively removes or pushes to the end one side of the grain boundaries and ridges associated therewith, while extending the length of the grain boundaries in the direction of stepping our motion, which would appear to be the types of actions being referred to in claims 12, 13 and like. Sposili et al. while teaching their SLS process for recrystallization of amorphous films such as silicon, further teaches that "such melting and we solidification is also useful post-doping annealing of semiconductor thin films" (col. 9, lines 41-43).

25. Claims 11-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sposili et al. (380) as applied to claims 1-10 above, and further in view of Yamasaki et al. (5,894,137), plus Fukunaga et al. or Kawasaki et al. (6,653,657 B2), as discussed in section 22 above.

While Sposili et al. does not specifically discuss using in selecting a third aperture patterns on a second top area it relates to a portion of the second area etc., as noted above they do suggest using their process not just for the initial crystallization but also for successive annealing processes, which as can be seen in the above discussed processes of Yamasaki et al. (137), Fukunaga et al. or Kawasaki et al., that the crystallization of amorphous silicon & formation devices such as TFT constructions, Main compass multiple annealing steps, that may employ multiple laser usages, or may employ strong light from lamps in a similar fashion, where the area that was initially crystallized, is again partially or wholly annealed again, possibly both before implanting for TFT formation, and thereafter. Therefore given Sposili et al.'s suggestion for using their process sequence also for post doping annealing, etc., it would have been obvious to one of ordinary skill in the art to employ such sequential annealing processes as taught in Sposili et al. for any of the laser annealing techniques as presented in the above combination of Yamazaki et al. plus Fukunaga et al. or Kawasaki et al., further noting that the previously discussed embodiments exemplified in these references, where they are forming TFT devices further teach laser annealing after doping, consistent with Sposili et al.'s specific suggestion of further usage.

With respect to the various claimed combinations of parameters, such as energy density, wavelength, etc., previously noted lamps and lasers employed in the secondary and tertiary references supply various claimed wavelength and pulse duration, etc., parameters for use in their process, as well as all references recognizing the importance of energy or light intensity or energy density impinged on the surface being treated, in order to control the effects of that light in the various crystallization, recrystallization & annealing processes, hence it would've been obvious to one of ordinary skill in the art to employ such teachings in optimizing the success of sequential processes as suggested by this combination, in order to produce desired and reproducible results. It is noted that due to the many clarity issues as discussed with respect to the 112 issues above, it is not possible to treat the individual claims more precisely at this time due to the confusion involved in their meanings.

With respect to claims 46-48 is noted that it is apparently impossible for all conditions that are required to be met by the claims to be simultaneously present as required, hence these claims appear to be unexaminable at this time.

26. Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by Moon (6,113,689) or Yang (2001/0019863 A1) or Kasahara (6,358,766 B1).

Moon (abstract; figures; col. 4, lines 4-55, especially 14-29; col. 6, lines 8-56), Yang (abstract; figures; [0014-21]; [0025]; [0028]; & [0040-41]), and Kasahara (abstract; col. 4, lines 35-63; col. 8, lines 35-60+; & col. 9, lines 21-68, specially 31-36 & 50-68), all have lateral solidification laser techniques of the SLS variety, which were reasons as abundantly discussed above, read on the very broad claim 1 as it is presently written.

27. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marianne L. Padgett whose telephone number is (571) 272-1425. The examiner can normally be reached on M-F from about 8:30 a.m. to 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

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MLP/dictation software

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